WHERE VALVES ARE USED

Tank Cars (/magazine/sections/where-valves-are-used/5827-tank-cars.html)

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The next time you're stopped at a crossing waiting for a mile-long train you think will never pass, take a good look at how many of those cars are tank cars. Doesn't it seem like many more tank cars are riding the rails these days?

If that's your reaction, you're right on the mark: Tank cars today are in a renaissance created by the abundance of rail-borne petroleum transport. The numbers today have not been this high since the U-boat threat of World War II pulled oil transport from open sea tankers onto the rails. In

VIDEO

2013, over 400,000 carloads of oil were shipped. Add to that the steadily increasing traffic on the railways and car-loadings of other types of fluids carried by railroad tank cars, and you can see the market is booming.

All this traffic is carried by a tank car fleet that currently numbers about 350,000 cars, and new cars are added every day.

For example, Valero Energy, the largest domestic oil producer, is investing nearly a billion dollars in doubling its tank car fleet from 5,325 to nearly 10,000 cars.

Every one of those tank cars is equipped with valves and fittings that are critical to the safe loading, transport and unloading of the products they carry.

Even though the tank car industry has had bad press over the past couple of years, brought about by a few catastrophic accidents, for the most part, the statistics back up the reality the tank cars are safe: 99.998% of all tank cars make the trip from producer to ultimate user without incident.

The tank car's promise as a method of transport for oil is not perceived to be short-lived, either. Some people have speculated that once new pipelines are built, the tank cars will go away. But the industry has two strong points in its favor. First, the cars can go anywhere there are rails, while a pipeline's location is fixed. This is important because, if a loading opportunity occurs 200 miles away in two to three years, it is easy to move the loading point. Pipelines underneath six feet of earth don't move too easily.

Second, the transport of crude oil from Canadian tar sands offers additional opportunities for tank car transport. The bitumen from which the Alberta tar sands is composed is so thick that, in order to get it to flow through a pipeline, it must be diluted with distillate. The flow is then 72% bitumen and 28% diluent, which makes the efficiency of the pipeline just over 70%. Using ordinary tank cars requires a mix of 83% bitumen to 17% diluent for loading and offloading. Also, the 83% mixture is carried in standard tank cars built with steam-heating coils (and more valves, by the way), which allow the bitumen to be unloaded with relative ease. Raw 100% bitumen can even be carried in tank cars; however, the contents must be heated to 200 degrees to get non-diluted contents to flow out of the car.

One transportation economist has stated that rail-shipping this heavy, sour mixture to Gulf Coast refineries, which are well-equipped to handle sour crude, presents a savings of three dollars a barrel over the pipeline route. Another advantage over pipelines is that the tank cars are available right now, while the Keystone XL pipeline and others may remain political prisoners for years.

THE VALVES

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There are three types of tank car designs: low pressure, high pressure and cryogenic. These can be further differentiated as insulated and non-insulated types.

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A high flow PRC used in transporting crude oil and ethanol

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Each tank car has at least two valves—an inlet/outlet valve and a pressure relief valve (PRV). These valves are located either on the top center of the car or, less frequently, on the bottom center.

The need for a basic inlet/outlet valve is obvious; the fluid needs to be contained after filling the car. The relief valve is necessary because, like any other vessel filled with fluid, over-pressurization can occur if the fluid expands because of temperature changes. Sometimes a vacuum relief valve is needed to keep the tank from imploding as it is emptied. While relief valves are most common for this use, rupture discs or rupture pins are also sometimes employed.

Many tank cars are supplied with heating coils that allow the temperature of the tank to be raised before unloading to make the removal of viscous/semi-solid materials much easier. These coils are usually heated via steam at the unloading site, and these cars require additional inlet and outlet valves to control the steam flow.

If the fluids transported are cryogenic, the valves need to be suitable for cryogenic temperatures. This would require extended bonnet gas columns and sealing materials, and designs that function properly at super-cold temperatures.

Aside from the PRVs, today's tank car valves are either ball or angle-globe types. In a few cases, plug designs also may be employed, although their usage has greatly decreased over the past few decades. Because of the compact design of the ball valve, such valves are commonly used on tank cars, but they have some unique design requirements. Two-piece, threaded body designs must have the tailpiece secured to the body. Also, the overall end-to-end dimensions of a railroad-use ball valve are generally shorter than those used in other service. The angle valve, however, is still specified for some service requirements, such as chlor-alkali transport.

TANK CAR VALVE STANDARDS

Many of the variety of fluids carried by the tank cars that crisscross the country every day are hazardous and/or combustible. To maintain a high level of design integrity, tank car valves are built in accordance with standards that address those risks. The most common are those of the Association of American Railroads (AAR). Basic tank car specifications are detailed in AAR's M-1102, Manual of Standards and Recommended Practices and Specifications for Tank Cars.

Approvals of tank car valve designs are done by the AAR tank car committee. Existing approved valves are also reviewed every 10 years. This includes PRVs, vacuum relief valves, and liquid and vapor loading/unloading valves.

Approval of a valve for one commodity does not necessarily approve it for other commodities. The commodity types are:

- Compressed gases
- Corrosives
- Solids requiring heat to solidify
- Products with special temperature requirements

The AAR tank car valve requirements are detailed in Appendix A of the AAR M-1102 document. One requirement that separates tank car valves from their stationary cousins is the need for heartiness. For example, a PRV for tank cars not only has crack and flow requirements, it "must be designed to withstand horizontal acceleration of 20 times the force of gravity without causing the valve to fail or to not comply with the start-to-discharge and vapor-tight pressure requirements, and without stressing any parts beyond the yield point of materials used in their assembled condition."

Specific materials of construction must be resistant to corrosion or solvent properties of the fluid to be carried at rated service temperatures. Stem materials for PRVs set at 75 psig or more must not be free machining, cold drawn (unless stress relieved) or made from cast materials.

CHLOR ALKALI SERVICE

Tank car valves in chlor alkali service are described in the detailed specifications published by the Chlorine Institute (CI). Chlor alkali valve commodities include chlorine, sodium, hydroxide, potassium hydroxide, sodium hypochlorite and hydrogen chloride. These highly corrosive chemicals require valve designs and materials specifically designed and built to handle the rigorous requirements imposed by chemicals.

The most useful CI valve standards relating to tank cars are:

- Pamphlet 6, Piping Systems for Dry Chlorine
- Pamphlet 98, Recommended Practices for Handling Hydrochloric Acid in Tank Cars
- Pamphlet 166, Angle Valve Guidelines for Chlorine Bulk Transportation
- Pamphlet 168, Guidelines for Dual Valve Systems for Bulk Chlorine Transport

The CI has an approved manufacturers list for valves. The approved designs are published in pamphlets 166 and 168 and include detailed cross-sectional OEM drawings of each valve.

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The angle valve is still the first choice for loading and unloading valves in chlor alkali service. The basic angle design is hearty and works well in the man-way atop each tank car. Because these valves handle highly corrosive media, design features include Hastelloy and Monel trim components and Teflon packing. For even higher integrity sealing and control of fugitive emissions, CI also has approved a bellows-sealed bonnet design.

While CI-approved valves are highly engineered products, they also are designed for ease of field or shop repair, which is appreciated in the field because oftentimes, basic valve repair work is handled by tank car repair firms, not in valve service facilities.

The repair of tank car valves also must be performed by an AAR-certified facility. AAR has a variety of certification levels for the tank car industry ranging from A through L. For companies that only repair tank car valves and not the cars themselves, an AAR Class F certification is required.

PROPOSED TANK CAR UPGRADES

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Although railroad transport has received bad publicity from a few incidents, tank car transport is statistically very safe.

The catastrophic accidents of recent times have directed much scrutiny to the ubiquitous tank car. Part of the reason for an increased frequency of incidents is because the railroads have created virtual pipelines via tank car "unit trains." These special, all-tank car trains make economic sense for the railroads, but they increase the safety risk because they mean that over 100 tank cars may be carrying the same hazardous cargo on the same train.

Also, the huge upturn in shale oil and the rail-borne transport of that oil have vastly increased the need for tank cars. Yet the bulk of the North American tank car fleet was built using a 1960s design called the "DOT 111." These older, DOT 111-designed cars are perfectly suited for handling many materials, but some need improvements to better handle the increased volume of highly hazardous flammable ethanol and sweet crude products that dominate the tank car transport market today.

While most proposed tank car improvements are shell and coupler upgrades, valve improvements have not been overlooked. Such improvements focus mainly on tank car relief valves. One proposed change would be to eliminate rupture disc, rupture pin or other one-time-use pressure relief devices, replacing them with standard PRVs. Another upgrade would mandate using high-flow-rate PRVs.

While all proposed upgrades make safety sense, the problem with implementing them is logistics. Of the current tank car fleet, about 78,000 cars require upgrading or replacement. Meanwhile, the pressure from the general public and government does not balance out with the industry's capacity to upgrade or manufacture new cars in the record time that would be required.

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THE END PICTURE

Tank cars have always been a viable option for bulk liquid transportation in the United States. The renewed popularity of these pipelines on wheels offers many challenges and opportunities for both the rail car manufacturer and those who make the valves used in those cars.

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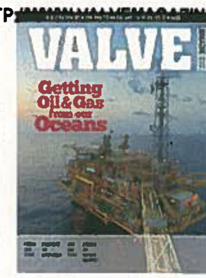

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